

GENERALIZED INSTRUCTION FOLLOWING WITH PICTORIAL PROMPTS

CARA L. PHILLIPS AND TIMOTHY R. VOLLMER

UNIVERSITY OF FLORIDA

The benefits of permanent pictorial prompts in enhancing maintenance and generalization are likely dependent on their degree of stimulus control and the extent to which their use is generalized. Although several studies on the use of pictorial prompts have demonstrated their efficacy (e.g., Pierce & Schreibman, 1994; Wacker & Berg, 1983; Wacker, Berg, Berrie, & Swatta, 1985), there is still some question regarding what ultimately controlled responding. The present study allowed an explicit examination of stimulus control by pictorial prompts. Three 4-year-old children with developmental disabilities were taught to complete 4 instructional sets (5 steps each) using pictorial prompts such that the prompts would control responding. All 3 participants showed generalization to the final set after training with 3 sets. These results suggest that training a single task sequence may not be sufficient for acquisition of generalized pictorial instruction following. However, establishing stimulus control by the pictorial prompts rather than teaching behavioral chains may facilitate acquisition of a generalized repertoire.

Key words: developmental disabilities, pictorial prompts, generalized instruction following, preschool children

Task analysis often is used when teaching individuals with developmental disabilities to complete complex tasks or behavioral chains. Task analysis involves breaking complex multi-component tasks into discrete steps that can then be taught as a behavior chain in which the stimulus products of each step function as the discriminative stimulus for the next step and as the conditioned reinforcer for the previous step (Skinner, 1953). A significant body of research indicates that task analysis is a useful method for training widely diverse skills, including activities of daily living, vocational tasks, and leisure skills (e.g., Bellamy, Horner, & Inman, 1979; Horner & Keilitz, 1975; Neef, Parrish, Hannigan, Page, & Iwata, 1989; Page, Iwata, & Neef, 1976; Richman, Reiss, Bauman, & Bailey, 1984). Typically, teaching a task-analyzed skill requires intensive training that includes instructor-delivered prompts. These prompts must be faded until the naturally occurring discriminative stimuli inherent in the behavior chain gain

control over responding. However, individuals with developmental or intellectual disabilities may become dependent on these instructor-delivered prompts, thereby restricting their level of independence (e.g., Billingsley & Romer, 1983; MacDuff, Krantz, & McClannahan, 1993; Steed & Lutzker, 1997).

An alternative to fading instructor-delivered prompts is to provide pictorial prompts. Wacker and Berg (1983) referred to these as “permanent prompts” when relied on for maintenance of complex tasks. In this sense, pictorial prompts can function as a self-management tool that allows the individual to function in the absence of staff or caregiver supervision despite dependence on prompts. Pictorial prompts have been used to teach or schedule cooking and meal preparation (Johnson & Cuvo, 1981; Martin, Rusch, James, Decker, & Trtol, 1982), activities of daily living (Pierce & Schreibman, 1994), leisure skills (MacDuff et al., 1993), and vocational tasks (Minarovic & Bambara, 2007; Sowers, Verdi, Bourbeau, & Sheehan, 1985; Wacker & Berg).

An important consideration in the use of pictorial prompts involves the objective: Is the

Correspondence concerning this article should be addressed to Timothy R. Vollmer, Department of Psychology, University of Florida P.O. Box 112250, Gainesville, Florida 32611 (e-mail: vollmera@ufl.edu).
doi: 10.1901/jaba.2012.45-37

objective to teach the individual a particular skill (a worthy objective) or to develop a generalized repertoire of following novel pictorial instructions (also a worthy objective)? A blending of these two objectives is evident in the existing literature and has implications for whether pictorial prompts or a picture schedule is appropriate for any given application. In the pictorial prompt literature involving task-analyzed behavior chains, the tasks were novel but the sequence was consistent. In the literature regarding picture schedules, the tasks were known but the sequence was novel.

Wacker and Berg (1983), for example, taught five adolescents with moderate to severe intellectual disabilities to complete two complex vocational tasks (from 18 to 43 steps) using pictorial prompts and a three-phase training package. All five participants acquired the tasks quickly (range, 4 to 11 sessions per task). In addition, three of three participants who participated in a generalization assessment showed generalization to two additional tasks. Given their results and those of the previous literature on pictorial prompts, the authors proposed three potential benefits of pictorial prompts. Pictorial prompts may (a) support independence when used by individuals with developmental disabilities for self-management, (b) enhance maintenance when used as permanent prompts, and (c) facilitate generalization to novel environments or to novel tasks. The former type of generalization is simply a matter of transferring the pictorial prompt system to the novel environment, but the latter is a more complicated issue; it would require the development of a generalized repertoire of following cues, or instructions, provided in the pictorial mode. All three of these potential benefits depend on the pictures exerting stimulus control over the target behavior. That is, an individual must learn to perform the action depicted in the picture or follow the picture as an instruction, rather than acquire a response chain. The results of several studies on pictorial prompts leave open the question of whether pictorial prompts typically

functioned as discriminative stimuli in this manner.

In the study by Wacker and Berg (1983), stimulus control and the acquisition of a generalized skill repertoire can be inferred from the data on generalization. However, these authors also more directly assessed stimulus control by performing a reversal-like probe in which they removed the picture book. They found that performance suffered on the generalization tasks when the picture book was removed but was maintained in the two trained tasks. This finding suggests that the initial training package may have resulted in both a generalized skill repertoire and acquisition of a behavior chain. Thus, it is possible that the pictures lost stimulus control in the case of the trained tasks. Similar results have been reported in other studies in which removal of pictorial prompts was assessed (e.g., Pierce & Schreibman, 1994; Wacker et al., 1985).

Similar results also were reported in studies in which stimulus control exerted by the pictorial prompts was not assessed directly but could be inferred from the data. For example, Martin et al. (1982) reported that after training with picture recipe books, individuals with developmental disabilities did not use the pictures reliably (i.e., turn the pages of the book), yet they continued to perform correctly. Thinesen and Bryan (1981) reported a similar effect when pictures were used to train grooming skills to adults with developmental disabilities. In both cases, it is possible that stimulus control by the pictures waned as the natural behavior chain was established.

From a standpoint of teaching a particular skill, sustained performance in the absence of pictorial prompts is perhaps ideal. However, it is possible that in some cases, an alternative form of prompt delivery might be more efficient than pictorial prompts. For example, although many studies reported rapid acquisition of tasks trained with pictorial prompts (e.g., Feldman, Ducharme, & Case, 1999;

Frank, Wacker, Berg, & McMahon, 1985; Martin et al., 1982; Wacker & Berg, 1983), extensive training was required to establish responses to pictorial cues in other cases (e.g., Connis, 1979; Pierce & Schreibman, 1994; Wacker et al., 1985). It may be the case that some skills are acquired more rapidly with traditional (e.g., least to most) prompting methods than with pictorial prompts. However, pictorial prompts still could be beneficial if their use does indeed lead to the three advantages suggested by Wacker and Berg (1983). Given the possibility that these advantages depend on stimulus control by the pictorial prompts, it seems particularly important to consider the issues of stimulus control and generalization when examining their use. Efficient methods to establish a generalized skill repertoire of following pictorial instructions should be developed further.

The literature on picture activity schedules suggests one potential method for facilitating acquisition of a flexible, or generalized, skill repertoire of following pictorial prompts. Sowers et al. (1985), for example, taught four high school students with developmental disabilities to self-manage transitioning between vocational tasks using a picture schedule by first teaching the relation between the picture and the task, then establishing task completion in response to the picture, and finally presenting a series of pictures as an activity schedule consisting of seven tasks. The seven tasks selected and the order in which they appeared were varied across days (one session per day). Unfortunately, the authors did not provide data on the total amount of training time required. However, it appears from the data that all participants learned to make transitions between activities in any sequence within 1 month of training. The ability to make transitions correctly when the sequence was changed daily implies stimulus control by the pictorial prompts. MacDuff et al. (1993) reported similar findings regarding the use of picture

schedules with four boys with autism aged 9 to 14 years. As in Sowers et al., the researchers taught the participants to engage with novel activities in response to the pictures prior to including them in the picture schedule. Thus, the participants only needed to learn to follow a novel sequence and not to engage in novel behavior in response to an untrained pictorial prompt.

The Sowers et al. (1985) and MacDuff et al. (1993) studies suggest a method for assessing stimulus control and possibly for establishing a generalized pictorial instruction-following repertoire that has not been examined with the use of pictorial prompts when training novel tasks. The purpose of the present study was to expand the research literature on the use of pictorial prompts to establish multicomponent behavior chains or sequences by partially replicating the procedures of Wacker and Berg (1983) but with the inclusion of the manipulation of sequence as described by Sowers et al. The sequence of pictorial prompts was manipulated throughout the current study to allow a more explicit demonstration of stimulus control by the pictorial prompts, to encourage the development of stimulus control by the prompts, and to establish a generalized skill set of following pictorial instructions. A generalized skill set was defined as participants responding correctly to novel pictorial prompts. Thus, the purpose of this study was not to establish one or more behavior chains but rather to establish a generalized repertoire of following instructions indicated by pictorial prompts. Evidence for such a generalized skill set would be correct performance to a novel set or at least a novel arrangement of pictorial prompts rather than continued performance of a previously taught sequence.

METHOD

Participants

Three 4-year-old children participated. Although all three had been diagnosed with a speech-language delay and received speech

therapy services, each could speak in full sentences and follow vocal instructions. Their teacher had referred all three students for participation because they had difficulty completing tasks in the classroom without prompting from an adult. Brandon had been diagnosed with emotional disability or disturbance. Jason had been diagnosed with an autism spectrum disorder. Jerome had been diagnosed with developmental disability. Although the children's teacher had posted several pictorial task analyses in their classroom, she had not made any formal attempts to teach responses to them.

Setting

All sessions were conducted in a public school in a large common area adjacent to the participants' classrooms. The room contained a small kitchen area, shelves for toys, three tables, and chairs. Sessions were conducted at one of the tables. The participant sat oriented towards the wall, with the therapist seated to his left. Due to the nature of the area, other children were sometimes present during sessions but were never seated at the table with the participant and researchers. Two to four sessions were conducted per day, up to 5 days per week. Throughout all phases of the study, a 2- to 5-min break with access to preferred toys or small bites of an edible item were provided between sessions, independent of performance.

Materials

The materials consisted of four toy sets with multiple component pieces that could be used to perform five distinct response sequences. These sets were a toy barn (barn, horse, hay, sheep, cow, tractor with farmer, airplane with farmer); plastic food task (plate, cutting board, knife, strawberry, onion, orange, peas); dollhouse (dollhouse with furniture, doll, dog, cat, truck); and a table setting (red construction paper square, blue construction paper circle, plate, cup, knife, spoon, and plastic banana). For each set, five simple responses, or steps (defined as the individual response indicated in

each picture for that set), were developed. Each step was designed to be independent from the other steps, such that the order of the steps could be changed. Thus, the children were taught to complete behavior sequences rather than behavior chains per se. Pictorial instructions were provided on laminated pages in a small binder (4 in. by 6 in.). Each page contained a strip of hook-and-loop tape on which a single picture was affixed. The final page of the book was printed with the words, "All done!" All pictures were taken with a digital camera and depicted a close-up of a research assistant completing one step of the response sequence (only hands and materials were shown in each picture). Figure 1 depicts one of the photo sequences as seen by the participant.

Dependent Variables and Response Measurement

Percentage correct. The percentage of steps completed correctly was the primary dependent measure. This measure was calculated by dividing the number of steps completed independently (in the absence of any instructor delivered prompt) by five (the total number of steps in each task) and multiplying by 100%. Correct performance was defined as completing a step in the correct order in the sequence and as depicted in the picture (i.e., if the photo of cutting the strawberry was the third picture, cutting the strawberry had to be the third response). The response did not have to be completed in the presence of the picture to be considered correct, nor did any previous responses have to be correct. Thus, each step was independent from the other steps in the sequence and could be performed correctly or incorrectly regardless of performance on the other steps. A step could be scored as incorrect for three reasons: (a) The child completed an action with the object depicted, but the action was not the one depicted; (b) the child performed an action with an object that was a part of the sequence, but did so out of sequence; or (c) the child performed some response that was not consistent

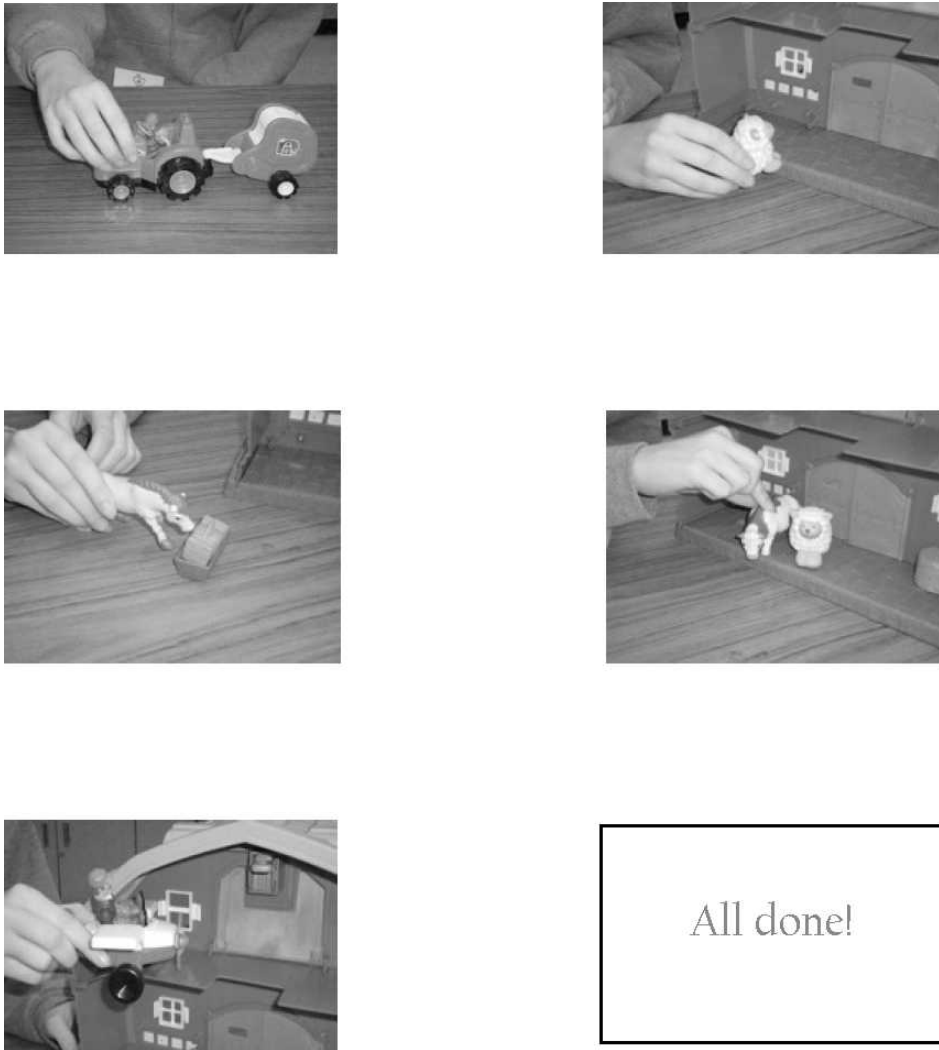


Figure 1. An example of one of the picture sequences (the barn). Each picture was placed alone on a page of a binder. The pictures were placed on hook-and-loop tape to allow the photo sequence to be changed. The final page ("All done!") signaled the end of the session.

with any of the steps of the sequence. When a response was incorrect, the participants' behavior was not always as discrete as it would be when correct instruction following occurred. Therefore, each series of responses that occurred with a single object was considered a single step for scoring purposes. For example, a single step for the dollhouse consisted of a child walking the doll into the house, sitting it on the couch, and then placing it into the kitchen. The next step

would begin when the child released the doll or interacted with a different object.

Prompt level. During training, the level of prompt required to ensure a correct response was recorded. Tasks were trained using a six-step least-to-most prompt hierarchy. The prompting levels were (a) delay: no prompt was given for the 5 s to 10 s following the initial presentation of the picture book (and initial request to engage with the materials) or following completion of a

step; (b) vocal prompt (picture): the therapist told the participant to “do what it is in the picture”; (c) vocal prompt (specific): the therapist told the participant to perform the desired step (e.g., “Put the plate on the circle”); (d) gestural: The therapist pointed to the item or items required to complete the desired step while repeating the vocal (specific) prompt; (e) model: the therapist performed the step while repeating the vocal (specific) prompt; (f) physical: the therapist used hand-over-hand guidance to help the participant to perform the desired step.

Page turning. During all phases of the study, observers recorded whether the participants independently turned the pages in the picture book. These data were collected only for approximately 50% of the sessions for each participant. They were collected as a secondary measure of stimulus control and to be consistent with the previous literature. However, these data are not reported here, because it was determined that they did not add to the analysis of stimulus control.

Data on all responses were collected using paper and pencil. A data sheet was created with a column in which the order of the steps required for correct performance could be recorded prior to the start of each session. The data sheet had columns for independent page turning, independent step completion, each of the prompt levels described above, and a column to record any behavior not included in the sequence or out of sequence. Data collectors recorded Y or N in each column for correct (Y) or incorrect or no responses (N), respectively, for each step in the sequence. In addition, during baseline and novel sequence probes, the observers recorded exactly which form of behavior the participant engaged in when he was not performing the steps or performing them out of sequence. Data also were collected (by circling “yes” or “no”) on whether the participant opened the picture book and read the final “All done!” page.

Interobserver Agreement

Two observers independently recorded data on page turning, correct step completion, and

prompt level for Jason, Brandon, and Jerome on 68%, 63%, and 46% of sessions, respectively. An agreement was scored for each step in each session if both observers recorded that step as independent or scored the same prompt level. Interobserver agreement scores were calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean agreement scores were 98% (range, 80% to 100%), 89% (range, 60% to 100%), and 95% (range 80% to 100%) for Jason, Brandon, and Jerome, respectively.

Independent Variable and Design

A multiple-probe design was used to examine the effects of training and manipulation of picture sequence within each toy set and to examine generalization across sets. During baseline with the first sequence (BL:S1) and training, each task was presented in a single consistent sequence in which the pictures that corresponded to all five steps always were presented in the same order. The sequence then was changed during the novel sequence baseline (BL:S2) after training, but all five steps still were presented in the book at one time. If the participant did not meet mastery criterion of three consecutive sessions at 100% correct with the novel sequence, then pictures were presented one at a time on the first page of the book (single instruction). The only other page present in the book during single instruction training was the final “All done!” page. Probes of each set in the initial sequence were conducted prior to implementing training with the first set in the first sequence. After the data were stable based on visual analysis, the first set was trained. Following training with the first set, a second sequence was assessed with the first set while periodic probes of the first sequence for the other sets continued. These probes were conducted when there was some indication of progress in the set that was being trained at the time. The order of conditions is depicted in Figure 2.

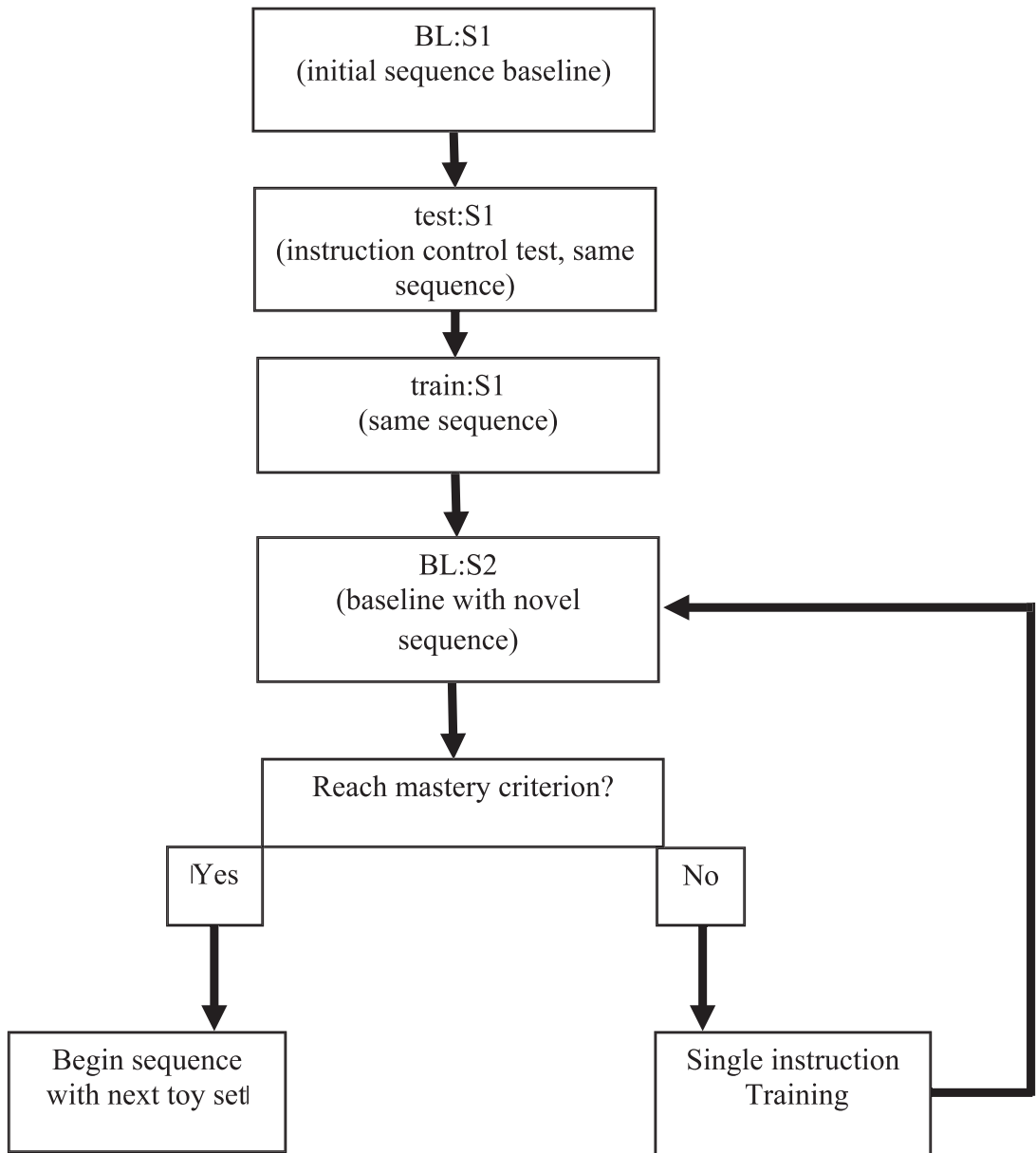


Figure 2. The order of conditions for all phases of the study.

Conditions

Assessment. Prior to beginning the treatment evaluation, the participants were assessed to be certain that they had certain prerequisite skills. First, they were tested for receptive identification of all of the specific items that were to be used in each of the toy sets. This involved presentation of an array of five to eight items

and asking the child to “point to [the item].” Next, participants completed a matching-to-sample assessment (picture to object) to determine if the participants could demonstrate the relation between pictures and their corresponding objects. This assessment involved presentation of an array of five to eight items (not the items used in the sets), then giving the

participant a picture corresponding with one of the items and telling him to “match” or “put with same.” Approximately 20 to 30 items were tested to provide evidence of a generalized picture-to-object relation. Finally, participants completed an assessment of vocal instruction following in which they were asked to complete simple single-step actions with a variety of objects (again, not the items used in the sets). Again, approximately 20 to 30 separate instructions were evaluated. Participants were exposed to two sessions of each of the above assessments and had to demonstrate proficiency separately in all to be included in the study (defined as scoring above 90% on both sessions in each of the three assessments).

Baseline. During the initial baseline (BL:S1), the materials for one of the toy sets were placed on the table in front of the participant (one set per session, set order was determined at random). The participant was given the picture book that contained the steps for that toy set and a specific vocal request to engage with the item (e.g., “show me how you set the table” or “show me how you play with the [barn, veggies, or dollhouse]”). No other prompts were provided. Nonspecific praise (e.g., “I like how you are working”) was given for engaging with the materials but was not contingent on correct performance. No other feedback was provided. For each set, the steps were in the same sequence for all baseline, instruction test, and initial training sessions.

Page turning. When responding was stable on at least one set in baseline, the participant was trained to use the picture book. All pictures were removed from the book during this phase. The picture book was placed in front of the participant, and he was vocally instructed to “open the book.” He then was prompted as needed (using a standard least-to-most prompt hierarchy) to turn each individual page of the book until he reached the final “All done!” page. He was given an echoic prompt to say “all done” and then was permitted to take his

postsession break. Page turning was considered mastered when the participant opened the book, turned all pages, and stated “all done” in the absence of prompts for three consecutive sessions. After page turning had been trained, baseline probes were continued for all toy sets until at least one set reached stability based on visual analysis. Page turning was trained only once. That is, there were no additional page-turning training sessions prior to teaching Sets 2 through 4.

Instruction test (test:S1). This condition was designed to assess the possibility that the participant could perform the steps in response to the pictorial prompts but required an instruction in order to do so. In other words, it was used to assess the possibility that stimulus control could be transferred easily from the instructor-delivered prompts to the pictures through the use of a rule (also in the form of an instructor-delivered vocal prompt). Conditions were as in baseline, with the exception of the form of the initial vocal request to engage with the items. In this phase, the therapist added the phrase “do what is in the pictures” to the initial vocal request to engage with the items. For Jerome’s third and fourth toy sets, a second rule was added to the first that consisted of “do them in order.” Again, this phase continued until the data were stable based on visual analysis or until mastery criteria were met, whichever came first. If mastery criteria were not met in the instruction test, then training began.

Training. Sessions were set up exactly as in baseline. The items for the targeted toy set were on the table. The participant was given both the book with the corresponding pictures for that set and the specific vocal instruction to engage with the materials. The therapist then waited 5 s to 10 s for the participant to open the book. If he did not respond or began to engage in an incorrect response, the therapist provided a vocal prompt to open the book. The therapist waited 5 s to 10 s to allow the participant to

perform the action depicted in the first pictorial prompt. If he did not respond or began to engage in an incorrect response, the therapist implemented the least-to-most prompt hierarchy until the participant performed the step correctly. The participant was permitted 5 s to 10 s to respond between prompts. If the participant completed the step without any prompting, the therapist provided specific praise (i.e. "Look at that! You did just what was in the picture. You put the cow in the barn."). After the action was completed, with or without prompts, the therapist waited 5 s to 10 s for the participant to turn the page, thus beginning the next trial with the next step. Training continued until the participant completed all five steps without any instructor-delivered prompts for three consecutive sessions (100% correct).

Novel order probes (BL:S2). When mastery criteria were met, the pictures were resequenced for the mastered set. The new picture sequence was selected by continuously shuffling the pictures and selecting one at a time, such that no picture remained in the same ordinal position as in the initial sequence. The sessions were conducted exactly as in the initial baseline. If mastery criteria were met in this phase, then the set was considered mastered and the next set entered the instruction test. If mastery criteria were not met but responding was stable, single instruction training began.

Single instruction training. This condition was designed to enhance the salience of the picture prompts and to establish stimulus control by the pictures. All the pages were removed from the picture book except for the first and last ("All done!") pages. The materials and vocal instructions were as in all other conditions. One picture from the set was selected at random and placed on the first page before giving the picture book to the participant. After the book and initial vocal request to engage with the items had been given, training was implemented just as in the initial training condition. However, at

this stage the pictures were presented one at a time on the first page of the book. Thus, after the participant completed the first response (with or without instructor-delivered prompts), the therapist removed the picture from the page while in view of the participant and placed another picture from that set in its place. This pattern continued until all five steps had been completed. The least-to-most prompt hierarchy was used to ensure compliance, and specific praise was provided for independent responses. The sequence of the pictures varied across sessions. This phase continued until mastery criteria were met; then the participant was exposed again to the novel order probes (BL:S2; i.e., the second complete sequence).

Reinforcement probe during the instruction test. This condition was used only with the third participant for the third and fourth sets. This condition was identical to the baseline probes, but specific praise was provided for correct responding. Thus, reinforcement was provided for instances of generalization to determine if this would increase accuracy in the absence of formal training. No prompts were provided.

RESULTS

Figure 3 depicts Jason's results. The first panel shows responding in the food task (Set 1). During the initial baseline (BL:S1), although Jason never opened the picture book, he did perform a step occasionally in the appropriate sequence. Teaching page turning, as indicated by the arrow in the BL:S1 phase, had no effect on correct responding. The instruction test (test:S1), resulted in stable responding at 0% correct. When training of the initial sequence was implemented in the following phase with Set 1 (train:S1), Jason met mastery criteria within five sessions. In the novel sequence probe (BL:S2) for Set 1, he performed at 100% correct in all sessions.

Figure 3 (second panel) shows responding during the barn task (Set 2). As seen in the first phase (BL:S1), while Set 1 (food) was undergoing

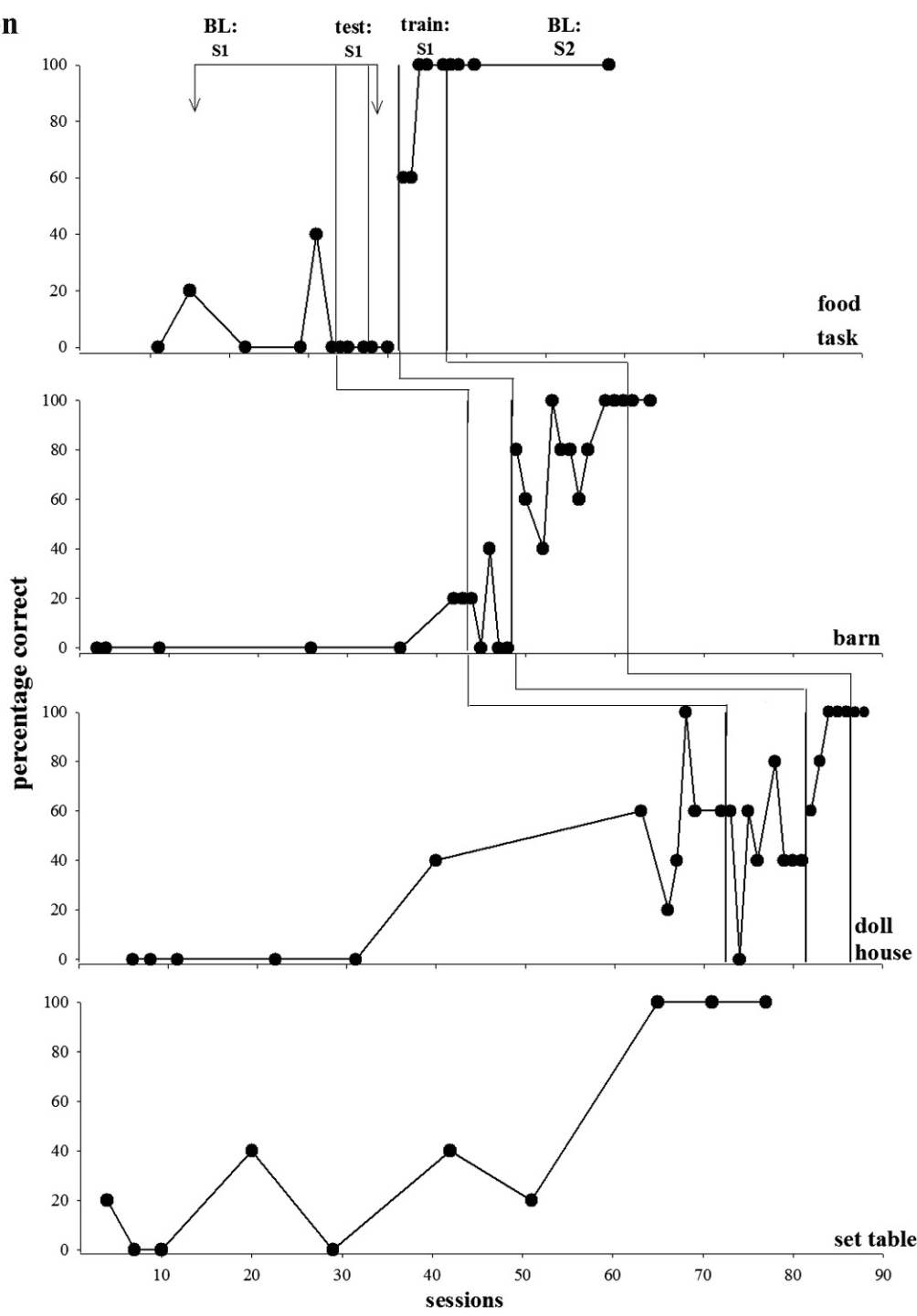


Figure 3. Percentage of steps completed correctly across the initial baseline sequence (BL:S1), instruction test (test:S1), training, and novel sequence baseline (BL:S2) for Jason. Each panel represents one of the four toy sets. Page-turning training occurred as denoted by the arrow in Set 1 (food task), between the third and fourth data points. Single instruction training was not required for any set.

training, Jason showed a slight increase in performance during baseline probes of Set 2 (barn). Again, the instruction test (test:S1) failed to establish correct responding. Immediately following the test:S1 phase, training of the initial sequence (train:S1) was initiated. Performance reached mastery criteria in 11 training sessions with the initial sequence of Set 2 (barn). As with the previous set, he made no errors during the BL:S2 probes.

Figure 3 (third panel) shows Jason's performance with Set 3 (dollhouse). His performance was similar to that of Set 2. He showed improvements in his performance with Set 3 during the first phase (BL:S1) when training was initiated with Set 1. As with the previous two sets, the test:S1 condition failed to establish correct performance. Performance on Set 3 met mastery criteria after five training sessions (train:S1). After training, he scored 100% on all novel sequence probes (BL:S2).

Figure 3 (fourth panel) shows Jason's performance on Set 4 (table). He met mastery criteria during baseline probes (a total of 10 baseline probes were conducted), with mastery-level performance coinciding with completion of Set 2 training. Thus, no instruction test or training was required for this set.

Figure 4 depicts results for Brandon. He did not perform any of the steps in the proper sequence during the initial baseline phase (BL:S1) with Set 1 (barn) (first panel). As with Jason, teaching page turning had no effect on percentage correct. The instruction test (test:S1) had no effect on responding with Set 1. Training of the initial sequence (train:S1) with Set 1 required 21 sessions. During the novel order probes (BL:S2) that followed the initial training, Brandon's performance improved dramatically compared to the initial baseline, but showed a decreasing trend (stabilizing at 40% correct after eight sessions; $M = 57.5\%$). Thus, single instruction training (single) was implemented, and he required seven sessions to reach mastery criteria. After this phase of

training, Brandon's performance reached 100% correct in the return to BL:S2.

Figure 4 (second panel) shows responding to Set 2 (food task). During the initial baseline (BL:S1), Brandon's performance on Set 2 remained at 0% for all but the second session. However, his performance improved to a mean of 73.3% during the instruction test (test:S1); and he required only three training sessions (train:S1) in the next phase to meet mastery criteria. He met mastery criteria for Set 2 in the BL:S2 condition within seven sessions. Thus, single instruction training was not required (it had been required for Set 1).

Figure 4 (third panel) shows Brandon's performance with Set 3 (dollhouse), which revealed a new pattern of responding. During the initial baseline (BL:S1), performance improved dramatically after training was initiated with Set 1. However, his performance gradually decreased and reached stability at 20% (11 sessions total, $M = 30.9\%$). His performance improved immediately during the next phase (test:S1), stabilizing at 80% correct within five sessions ($M = 64\%$). He consistently missed the same step (closing the dollhouse doors) with this set during the test:S1 phase. Performance reached mastery within four training sessions in the subsequent phase (train:S1) and stayed stable at 100% correct for the novel order probes (BL:S2) following training. The fourth panel shows Brandon's performance on Set 4 (table). His performance met mastery criteria after nine probes (overall the 98th session). Thus, training was not required.

Figure 5 depicts results for Jerome. Jerome's baseline performance across sets was the most variable of the three participants. However, his behavior with respect to Set 1 (dollhouse) was very similar to that of Jason during Set 1. During the initial baseline (BL:S1), Jerome did not perform any steps correctly. As with both Jason and Brandon, page turning was taught during the BL:S1 condition for Set 1 and had no effect on percentage correct. The instruction

Brandon

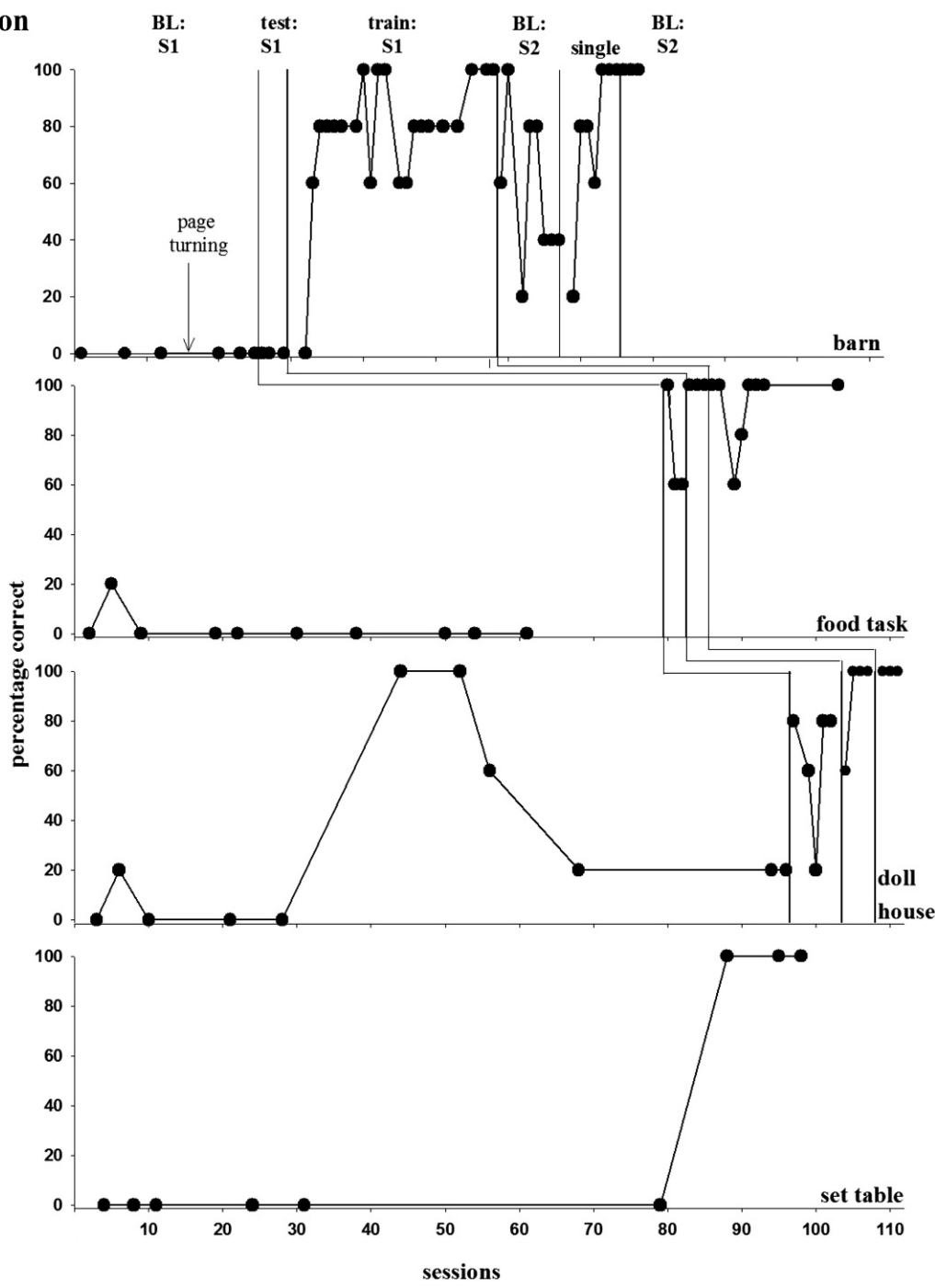


Figure 4. Percentage of steps completed correctly across the initial baseline sequence (BL:S1), instruction test (test:S1), training, single instruction training (single), and novel sequence baseline (BL:S2) for Brandon. Each panel represents one of the four toy sets. Page turning training occurred as denoted by the arrow in Set 1 (barn), between the third and fourth data points.

Jerome

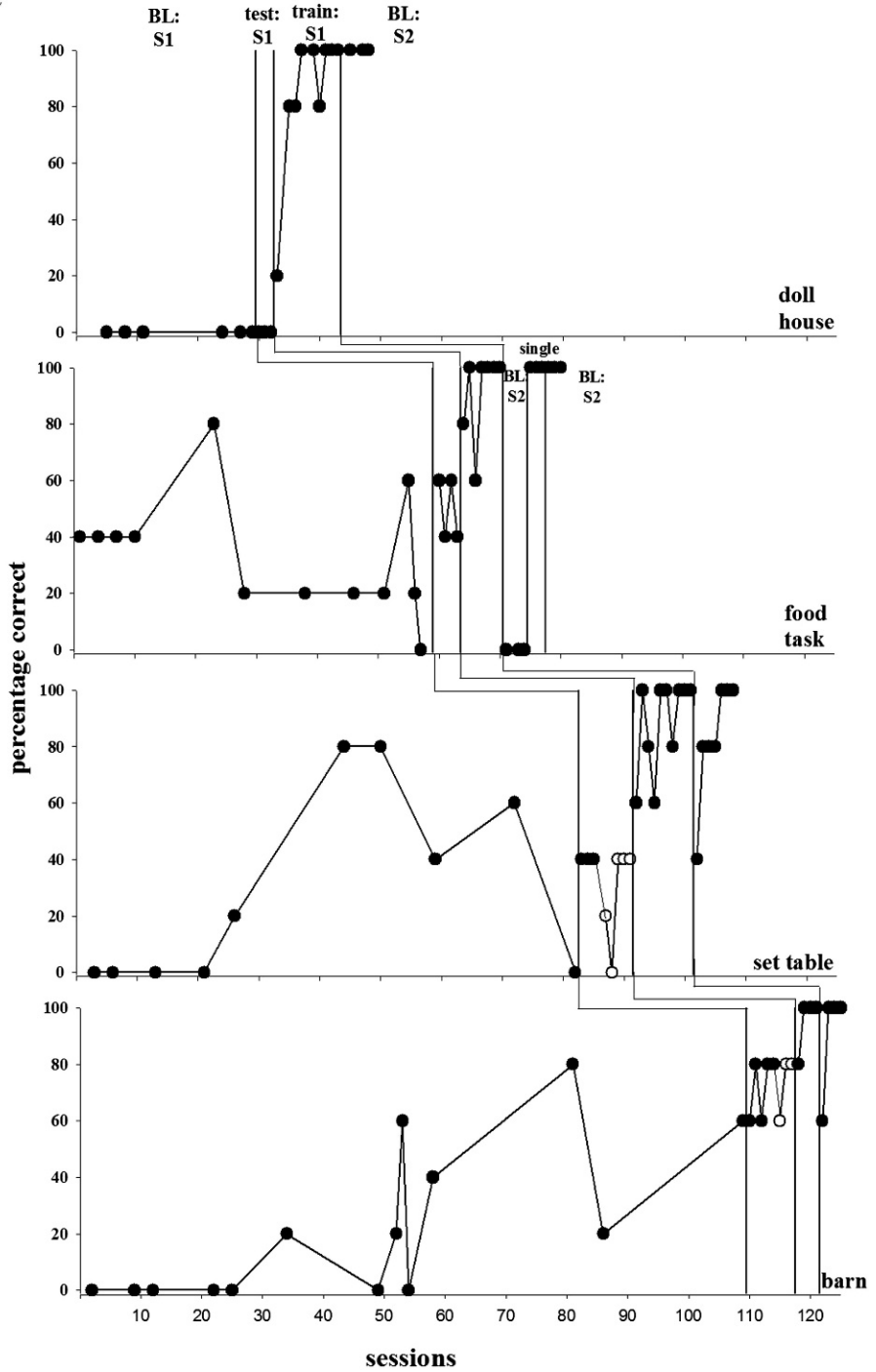


Figure 5. Percentage of steps completed correctly across the initial baseline sequence (BL:S1), instruction test (test:S1), reinforcement test (open circles in test condition), training, single instruction training (single), and novel sequence baseline (BL:S2) for Jerome. Each panel represents one of the four toy sets. Page-turning training occurred in Set 1 (dollhouse) between the third and fourth data points.

test (test:S1) had no effect on performance for Set 1. Following this test, initial sequence training was initiated (train:S1), and he required eight sessions to reach mastery. Jerome consistently performed all steps correctly with the novel sequence during the subsequent phase (BL:S2).

Figure 5 (second panel) shows responding to Set 2 (food task) and reveals a failure to replicate the pattern of responding seen with Set 1. During the initial baseline (BL:S1), Jerome performed one to four steps correctly, although he did not open the picture book at all during this or the subsequent instruction test phase (test:S1). The test:S1 condition again failed to establish correct performance. Following test:S1, training (train:S1) was initiated and Jerome's performance required six sessions to reach mastery. Unlike for Set 1, he did not respond correctly to the novel sequence in BL:S2 for Set 2 but typically completed only the first two steps in the sequence. Single instruction training thus was initiated, and he required only three sessions to reach mastery. Following single instruction training, Jerome performed at 100% correct in the return to the novel sequence probes (BL:S2).

Figure 5 (third and fourth panels) show Jerome's responding to Sets 3 and 4 (table setting and barn), respectively. During the initial baseline phases with both sets (BL:S1), his responding replicated the pattern seen with Set 2 in that he performed one to four steps correctly but his performance never reached mastery for either set. The subsequent instruction test (test:S1) again failed to establish correct performance for either set, with Jerome again showing a pattern of performing only the first two steps correctly for Set 3 and up to four steps correctly for Set 4. Providing specific praise for correct performance during baseline (indicated by the open circles during the test phase) had no effect on responding. Thus, training was initiated (train:S1) and required 10 sessions with Set 3 and four sessions with Set 4.

Adding praise for instances of generalization during the subsequent novel order probes (BL:S2) resulted in improvements in performance such that single instruction training was not required for either set.

DISCUSSION

Results of the current study are consistent in several respects with the previous literature on the use of pictorial prompts to train novel multicomponent responses. The pictorial prompts, in conjunction with instructor-delivered least-to-most prompts, were effective in establishing response sequences in all three participants. Very few training sessions (range, 3 to 21) were required to establish the initial sequences. All three participants showed at least partial generalization to a novel set after being trained with one to three sets. In fact, only Jerome required training with the final set due to consistently missing one of the five steps. Overall, these results suggest that these methods may be sufficient to establish a generalized pictorial instruction-following repertoire.

Furthermore, although generalization is most often indicated by responses in the absence of any training, it may also refer to the phenomena in which the amount of training required is reduced with each subsequent stimulus trained. This "savings effect," as described by Wacker et al. (1985) and Pierce and Schreibman (1994), was demonstrated with at least one set for two of three participants in this study. Brandon required 21 sessions to master the initial sequence with Set 1 but only three sessions to master the same with Set 2. In addition, Jerome required 7 to 10 sessions to master the initial sequence with the first three sets but only four sessions to master the same with the final set. This savings effect further supports the presence of a generalized repertoire with respect to following pictorial instructions.

These findings add to the literature by allowing an explicit demonstration of the controlling stimulus in the initial phases of

training. This was accomplished via the manipulation of the picture step sequence. If the training method established stimulus control by the pictures, then the participants' behavior should have conformed to the novel picture sequence. By the same token, resequencing the pictures after mastery of the initial sequence also allowed a demonstration of what precisely was learned during training, a response chain or a generalized repertoire of following instructions in the form of pictorial prompts. If a response chain was established, then the participants could be expected to continue to perform the sequence in the order previously trained (no stimulus control by the pictures, possibly no establishment of generalized skill set). If generalized pictorial instruction following was established, then the participants' behavior should have conformed to the current picture sequence (stimulus control by the pictures and demonstration of generalized pictorial instruction following within known sets). The multiple baseline design thus allowed further indication of the establishment of a generalized skill set. An analysis of the participants' page-turning behavior may have provided further demonstration of stimulus control. As in the previous literature, correct performance in the absence of page turning would be indicative of the establishment of a behavioral chain rather than control by the pictures. Unfortunately, it is a limitation of this study that we collected data on page turning for just 50% of the sessions. Although resequencing of the steps provides similar information as would data on page turning, future studies should perhaps obtain these data for all sessions. However, these data were not necessary for a demonstration of stimulus control with these methods and did not add to our analyses.

It is important to note that stimulus control by the pictures in each set was established with traditional training alone for only one of three participants. Essentially, the initial phase of training replicated the training procedures of

Wacker and Berg (1983), Wacker et al. (1985), Pierce and Schreibman (1994), and others. As was the case with these studies, the present study indicates mixed results regarding stimulus control by the pictures with traditional training. The pictures may not have acquired stimulus control over Brandon's responding after initial training with Set 1, as indicated by the results of the novel sequence probe. However, single instruction training was successful in establishing stimulus control by the pictures for this and all subsequent sets. Jerome's results are more difficult to interpret. Although he performed correctly with respect to the pictorial prompts when resequenced in the novel order probe for Set 1, he did not do so for Set 2. Jerome's performance may have been affected by a lengthy break (due to illness and the winter school break) during training on Set 2. However, similar to Brandon, Jerome required the single instruction training for only one of four sets.

Jason's data suggest that the pictures exerted some control over his behavior in all sets after training with just the first set. Furthermore, although he required training to master all five component responses in three of the four picture sets, his behavior always adapted to the change in sequence after responses within a set had been trained. This could indicate that he quickly acquired the generalized skill of following pictorial instructions but was hindered in task generalization because he could not always understand the specific instructions. That is, he could not always respond appropriately with respect to the pictured action. This possibility could be examined in future studies by teaching the specific motor responses to the individual pictures before putting the photographs into sets.

Brandon and Jerome each showed similar problems with one set. During the instruction test, Brandon consistently emitted the same incorrect action with Set 3 (dollhouse) in response to the picture that depicted shutting

the doors of the dollhouse. When Brandon reached that picture, he said, "They are already open," pushed the doors open further, and then moved on to the next picture. Jerome demonstrated a similar problem with his final set (the barn). He consistently completed four of five steps correctly prior to training on the barn sequence. His error was always on the same step (landing the airplane in the barn), and he always performed the same action with the airplane (flying it over the roof of the barn, then landing it on the roof) in response to the pictorial prompt. These responses illustrate that lack of specificity might be a potential limitation to the use of pictorial prompts. It can be very difficult to differentiate motoric responses depicted in still pictures. For example, a picture of opening and closing a bottle might look identical. Future research could involve training responses to symbols that would be paired with pictures to ease the discrimination between actions that look similar to one another in pictures. In addition, this limitation of pictorial prompts would not be seen with textual prompts. We are in the process of replicating these procedures with textual prompts with children with developmental disabilities who can read. It also would be important to replicate this study with additional prompt forms such as computer-delivered and auditory prompts.

One feature of these results suggests another potential limitation. All three participants showed initial increases followed by decrements in performance for at least one set after training with the first set. This result might indicate an extinction effect. Correct performance, which was praised during training, did not result in praise during baseline, instruction, and novel order probes. For two of three participants (Brandon and Jerome), there was a characteristic pattern of performing correctly for the first two or three steps before beginning to play with the materials. Thus, it is possible that providing praise for instances of generalization to novel sequences and novel probes might support

acquisition of the generalized skill set without requiring single instruction training. To examine this possibility, the reinforcement test condition was added for the final two sets for Jerome. Although providing reinforcement for correct responses during baseline sessions did not affect his responding, providing reinforcement for correct responses during the novel sequence probes did improve performance.

This pattern in Jerome's results reveals another potential limitation, in that generalization to the novel sequences may have been facilitated for Brandon and Jason had instances of generalization been reinforced. Future studies could include a component analysis in which the instructions, instructor-delivered prompts, and praise for correct performance are manipulated systematically to identify the most efficient training package components. Another limitation of this study was that generalization to more complex functional skills was not assessed. It was the intention to do so, but the academic year ended before the assessment could occur. This also should be addressed in future studies. For example, the use of the picture book to make lunch or perform other activities of daily living could be assessed before and after training with toy sets. In addition, modes of depicting the pictorial instructions that might be more amenable to use in the classroom or home (e.g., lists or charts) could be assessed in future studies. For example, it might be difficult for an individual to flip through a picture book for hand-washing prompts. In the case of chores like hand washing, a single-page pictorial sequence posted by the bathroom sink might be more feasible.

It should be noted that the participants in this study were considerably younger and also possibly higher functioning than the participants in previous research in this area. Despite their relatively proficient verbal repertoires, these children took longer to acquire the sequences than did many of the participants in these earlier studies. It is possible that their

age meant that they had less of a history for instruction following in general.

In addition, the demonstration of generalization calls into question experimental control when using a multiple baseline or multiple probe design. That is, generalization is demonstrated when the participant exhibits acquisition in the absence of the independent variable. This could be interpreted to mean that something other than the independent variable controlled responding. It is difficult to demonstrate both experimental control and generalization; however, it was accomplished here by the rapid acquisition from such low and stable baselines with the first set, along with the replication of effects across participants.

In conclusion, results suggest that training an individual to complete some tasks with pictorial prompts will not necessarily result in either stimulus control by the pictorial prompts or in a generalized repertoire of following pictorial prompts. However, these results do indicate that the acquisition of both stimulus control by the prompts and the generalized repertoire can be relatively rapid. All three participants in this study acquired the skill of following pictorial prompts in any sequence in less than 120 sessions in total. In addition, all three showed at least some generalization to at least one of four sets. Although this might seem like a great deal of training, sessions typically lasted 2 min to 5 min. Thus, total training time was less than 10 hr maximum. This is a very small amount of time required to train what is likely to be a useful generalized skill. It remains to be determined if there are more efficient ways to conduct training with these and other modes that will result in still more rapid generalized repertoires.

REFERENCES

- Bellamy, G. T., Horner, R. H., & Inman, D. P. (1979). *Vocational rehabilitation of severely retarded adults: A direct service technology*. Baltimore: University Park Press.
- Billingsley, F. F., & Romer, L. T. (1983). Response prompting and the transfer of stimulus control: Methods, research, and a conceptual framework. *Journal of the Association for the Severely Handicapped*, 8, 3–12.
- Connis, R. T. (1979). The effects of sequential pictorial cues, self-recording, and praise on the job task sequencing of retarded adults. *Journal of Applied Behavior Analysis*, 12, 355–361.
- Feldman, M. A., Ducharme, J. M., & Case, L. (1999). Using self-instructional pictorial manuals to teach child-care skills to mothers with intellectual disabilities. *Behavior Modification*, 23, 480–497.
- Frank, A. R., Wacker, D. P., Berg, W. K., & McMahon, C. M. (1985). Teaching selected microcomputer skills to retarded students using picture prompts. *Journal of Applied Behavior Analysis*, 18, 179–185.
- Horner, R. D., & Keilitz, I. (1975). Training mentally retarded adolescents to brush their teeth. *Journal of Applied Behavior Analysis*, 8, 301–309.
- Johnson, B. F., & Cuvo, A. J. (1981). Teaching mentally retarded adults to cook. *Behavior Modification*, 5, 187–202.
- MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis*, 26, 89–97.
- Martin, J. E., Rusch, F. R., James, V. L., Decker, P. J., & Trtol, K. A. (1982). The use of picture cues to establish self-control in the preparation of complex meals by mentally retarded adults. *Applied Research in Mental Retardation*, 3, 105–119.
- Minarovic, T. J., & Bambara, L. M. (2007). Teaching employees with intellectual disabilities to manage changing work routines using varied sight-word checklists. *Research & Practice for Persons with Severe Disabilities*, 32, 31–42.
- Neef, N. A., Parrish, J. M., Hannigan, K. F., Page, T. J., & Iwata, B. A. (1989). Teaching self-catheterization skills to children with neurogenic bladder complications. *Journal of Applied Behavior Analysis*, 22, 237–243.
- Page, T. J., Iwata, B. A., & Neef, N. A. (1976). Teaching pedestrian skills to retarded persons: Generalization from the classroom to the natural environment. *Journal of Applied Behavior Analysis*, 9, 433–444.
- Pierce, K. L., & Schreibman, L. (1994). Teaching daily living skills to children with autism in unsupervised settings through pictorial self-management. *Journal of Applied Behavior Analysis*, 27, 471–481.
- Richman, G. S., Reiss, M. L., Bauman, K. E., & Bailey, J. S. (1984). Teaching menstrual care to mentally retarded women: Acquisition, generalization, and maintenance. *Journal of Applied Behavior Analysis*, 17, 441–451.
- Skinner, B. F. (1953). *Science and human behavior*. New York: MacMillan.
- Sowers, J., Verdi, M., Bourbeau, P., & Sheehan, M. (1985). Teaching job independence and flexibility to mentally retarded students through the use of a self-control package. *Journal of Applied Behavior Analysis*, 18, 81–85.
- Steed, S. E., & Lutzker, J. R. (1997). Using picture prompts to teach an adult with developmental disabilities to independently complete vocational tasks. *Journal of Developmental and Physical Disabilities*, 9, 117–133.

- Thinesen, P. J., & Bryan, A. J. (1981). The use of sequential pictorial cues in the initiation and maintenance of grooming behaviors with mentally retarded adults. *Mental Retardation*, 19, 246–250.
- Wacker, D. P., & Berg, W. K. (1983). Effects of picture prompts on the acquisition of complex vocational tasks by mentally retarded adolescents. *Journal of Applied Behavior Analysis*, 16, 417–433.
- Wacker, D. P., Berg, W. K., Berrie, P., & Swatta, P. (1985). Generalization and maintenance of complex skills by severely handicapped adolescents following picture prompt training. *Journal of Applied Behavior Analysis*, 18, 329–336.

Received July 9, 2010

Final acceptance August 11, 2011

Action Editor, Nathan Call